SYNOPSIS

Ph.D. in Food Science and Nutrition

Effect of Nutrition Intervention Programs on Nutritional Status and Nutritional Knowledge of PCOS Young Adult Women

By

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a) Title of the Thesis

Effect of Nutrition Intervention Programs on Nutritional Status and Nutritional Knowledge of PCOS Young Adult Women

b) Brief description of the state-of-art of the research topic

Polycystic ovary syndrome (PCOS) is a common hormonal condition affecting women of reproductive age, often starting in adolescence. It is a leading cause of infertility, characterised by irregular periods, excess androgen levels, and polycystic ovaries and can lead to difficulties in getting pregnant. It is estimated that PCOS affects 6–13% of reproductive-aged women, but up to 70% remain undiagnosed. The exact cause of PCOS is unknown, but it is related to abnormal hormone levels. Symptoms include irregular or absent periods, excessive hair growth, weight gain, thinning hair, oily skin, and acne. PCOS is also associated with an increased risk of developing health problems later in life, such as Type 2 diabetes and high cholesterol. There is no cure for PCOS, but symptoms can be treated through dietary modifications, lifestyle changes, medication, and fertility treatments. Weight loss and a healthy diet can improve symptoms, and medicines are available to treat excessive hair growth, irregular periods, and fertility problems. Nutritional intervention programs, including nutrition education and dietary supplementation, can also help to manage PCOS symptoms and improve the nutritional status and nutritional knowledge of young adult women.

c) Definition of the problem

Polycystic ovary syndrome (PCOS) often goes undiagnosed until women seek help at infertility centres for irregular periods, highlighting a need for increased awareness and proactive intervention. Studies suggested that a holistic approach, including personalized dietary supplements, regular physical activity, stress management and accessible nutrition education via platforms like YouTube and WhatsApp, can empower women to manage PCOS effectively. Recognizing a significant gap in localized research, particularly in Thrissur, Kerala, this study focused on young women aged 18-21 years. The primary objective of the study was to evaluate the effectiveness of combining nutrition education, physical activity programs, and nutrient-dense health mix powder supplementation in improving their understanding of nutrition, overall health, and nutritional status related to PCOS. This research contributed valuable insights into tailored interventions for this specific target group.

d) Objectives

The researcher has conducted the present study with the following objectives.

Primary Objectives

- To elicit the data related to socio-economic profile, dietary and water intake and lifestyle pattern of the study subjects (18 – 21 years).
- To screen the young adult women (18-21 years) using the Rotterdam Criteria tool to identify PCOS subjects
- To assess the nutritional status using ABCD techniques for the selected study subjects
- To formulate and evaluate the nutrition education modules on PCOS and dietary supplements for PCOS.
- To evaluate the effect of nutritional intervention programs on symptoms of PCOS, Nutritional Status and nutritional knowledge of the selected PCOS subjects

Secondary Objectives

- To evaluate the nutritional knowledge and attitude related to PCOS among the study subjects.
- To assess menstrual regularity, exposure to sunlight, stress level, menstrual hygiene and physical activity level of the selected PCOS study subjects

e) Methodology

The present study consisted of six phases. The first phase, screening of young adult women (18-21 years) to identify PCOS, was conducted in different five colleges of Thrissur District. Based on the inclusion and exclusion criteria, a total of 1250 subjects were selected for the study. Among them, 25 per cent of the subjects were identified to have PCOS symptoms using the validated tool of Rotterdam Criteria. The questionnaire was validated by the experts to ensure the quality of the study tools for the collection of data related to the present study.

The second phase was the mapping of PCOS among the selected study subjects (N=1250) for nutrition interventions. This phase sought to evaluate dietary changes for the study subjects 120 with noticeable hirsutism and menstrual abnormalities. The pre-nutritional assessment procedure comprised a multimodal approach covering anthropometric, biochemical, clinical, and dietary intake of selected study subjects. Evaluation and treatment of polycystic ovarian syndrome (PCOS), a complicated endocrine condition marked by hormonal abnormalities, insulin resistance, and metabolic dysregulation, depend on an accurate biochemical profile. For the selected study subjects, Haemoglobin levels, random blood sugar (RBS), and cholesterol levels were estimated. Examining PCOS clinically, the medical history was thorough and concentrated on hirsutism and acne. Dietary consumption was evaluated and also perceived stress, activity routines, stress levels, menstrual hygiene practices, nutritional knowledge and

awareness of PCOS were assessed. Rotterdam (2003) diagnostic criteria guided the screening process for PCOS using the Self-Administered Polycystic Ovarian Syndrome Questionnaire.

Nutrient-dense health mix powder and nutrition education modules for the selected PCOS young adult women were developed and evaluated properly. The third phase was the nutritional evaluation of micronutrients like calcium, phosphorus, selenium, zinc, magnesium, Vitamin B complex, and fibre content of the health mix powder which was prepared from sesame seeds, ragi, oats, flax seeds, peanuts, sunflower seeds, and pumpkin seeds to three variations. Variation III scored the highest score when the health mix powder was evaluated for sensory attributes and nutrient contents. Physiological characteristics, microbiological safety, and possible heavy metal levels of the health mix powder were analysed. The cost-effective analysis evaluated the economic feasibility and affordability of the health mix powder. Combining offline and online sessions, instructional nutrition and health modules, a YouTube channel and WhatsApp groups, the nutrition education intervention program helped the study subjects follow a healthy lifestyle pattern for effective self-care management of PCOS.

Nutrition intervention programs for 90 days were assigned to the selected PCOS study subjects in the fourth phase. The study involved four groups of 30 PCOS subjects: a control group, which did not participate in nutrition intervention programs and groups second, third and fourth termed Experimental Groups. Second group study participants received nutrition and health education, focused on reproductive health and lifestyle modifications. Third-group study participants were involved in a structured exercise program, in terms of aerobic exercises, resistance training, and flexibility exercises to improve weight loss, and reduce androgen levels; and fourth-group participants were involved in a dietary intervention, which included a health mix powder supplement, nutrition education, and exercise programs.

The nutrition intervention programs consisted of two offline and three online sessions for PCOS nutrition education per week. PowerPoint presentations and videos were used in offline sessions to educate the study participants about pathophysiology, diagnostic criteria, nutritional advice, lifestyle changes, and stress management. Google Meet enabled online sessions that offered chances for conversation and clarification. Using a questionnaire to evaluate the study participants' PCOS knowledge and knowledge gaps were found the educational material was customized. The mix of in-person and online meetings guaranteed the accessibility and flexibility of the present research study.

The Nutrition Intervention Programme included Nutrition Education and a structured aerobic exercise for experiment group II. The program was conducted five days a week, with

sessions in the college's indoor stadium. The program was designed by experts, with a trained expert handling the sessions. The study participants engaged in warm-ups and aerobic exercises, gradually increasing intensity and duration over time.

For the benefit of experimental group III of Polycystic Ovary Syndrome (PCOS) study participants, a nutritional intervention program was executed. Following aerobic activity sessions, the study participants were instructed to have one packet of the health mix powder (35g per packet) and given one packet for consumption the next day morning. Based on individual dietary intake, dietary guidance and counselling were given. The approach also emphasized stress management, stress-lowering eating patterns, anti-inflammatory foods, mindfulness strategies, and sound sleep. Self-reported logs and regular check-ins tracked compliance while study participants were informed about the nutritional importance and health benefits of health mix powder used in dietary supplementation.

Phase V assessed the effect of nutrition intervention programs on the nutrition knowledge, nutrition status, and PCOS symptoms of the study participants. In phase VI researcher has done a statistical analysis of the findings to ensure the effect of nutrition intervention programs on the nutritional status and nutrition knowledge of the Study participants.

f) Original contributions

The study involved 1250 young adult women (18-21 years) from the Thrissur district, and revealed significant insights into their demographic profile. The majority of the study subjects were aged 19 (46 per cent), followed by 18 years (32 per cent), 20 years (17 per cent) and only a meagre per cent (5 per cent) were 21 years old. The religious status showed that 59 per cent identified as Hindu, while Christians and Muslims comprised 22 per cent and 19 per cent, respectively. Family structure analysis highlighted a predominant preference for nuclear families (87 per cent), with 59 per cent of the study subjects from smaller family structures having 1-4 members. Educationally, an overwhelming 99 per cent were pursuing graduate studies, reflecting a strong aspiration for professional advancement.

Socioeconomic Status (SES) was assessed through various aspects of income, education, and occupation. The findings indicated that a substantial portion of the selected subjects were in the lower middle class (40 per cent) and upper lower class (28 per cent), and 23 per cent were classified as upper middle class.

Data related to lifestyle patterns of the selected 1250 subjects were gathered and focused on dietary and lifestyle patterns, sleep length, physical activity frequency, and their interrelationships. The majority (64 per cent) of the selected subjects had sleep of six to eight

hours, which is regarded as ideal for preserving excellent health and cognitive ability. Seventy-seven per cent of the selected subjects did not participate in consistent physical activity, which could have contributed to problems related to health issues including obesity and abnormalities of reproduction. The most often used form of exercise among the majority (69 per cent) of the selected subjects who worked out for about thirty minutes which was brisk walking.

Thirty per cent were underweight and had a BMI < 18.5. Normal BMI (18.5–24.9) for 59 per cent of the selected subjects and considered as the healthy population. Nine per cent were overweight (BMI 25.0–29.9), one per cent were obese in grade I (30.0–34.9), and one was in grade II (35.0–39.9) and grade III (≥ 40.0).

This study analysed the dietary patterns of the selected subjects and revealed that 88 per cent followed a non-vegetarian diet, with only eight per cent adhering to vegetarian, ovo-vegetarian, and lacto-vegetarian diets. Over half of the selected subjects skipped meals, particularly breakfast, due to a dislike of certain breakfast items, lack of appetite, time to rush the college and lack of time. A high percentage of the selected subjects (77 per cent) rely on external food sources, leading to a dietary pattern characterized by higher levels of unhealthy fats, sugar, and preservatives, potentially worsening PCOS symptoms. The preference for sweet (31 per cent) and spicy foods (48 per cent) might not be aligned with dietary recommendations for managing PCOS.

The study revealed significant dietary patterns among the selected subjects, particularly concerning fried snacks, non-vegetarian snacks, carbonated drinks, sweet items, and bakery products. High daily sugar consumption (60 per cent) among the selected subjects was alarming and suggests the need for dietary modifications. The Food Frequency Table reveals significant dietary habits among the selected subjects, particularly those with Polycystic Ovary Syndrome (PCOS). The study found that 76 per cent of the selected subjects consumed cereals, suggesting whole grains as the staple foods. Pulses were also consumed daily by 38 per cent and alternatively by 44 per cent of the selected subjects. Green leafy vegetables were essential for reducing inflammation and improving metabolic health and were included daily in the diet of 16 per cent of the selected subjects. Dairy products were consumed by 44 per cent of the selected subjects, among them 44 per cent consumed milk and milk products daily. The high sugar consumption (61 per cent) suggested the need for dietary modifications. The study also found three distinct dietary patterns: High-Fat and Sugar-Rich, Vegetable-Centric, and Cereal and Pulse-Based. The high-fat and sugar-rich pattern might have contributed to PCOS progression, while the vegetable-centric pattern might have had a protective effect.

The study gathered data related to beverage intake and the frequency ranges of the selected subjects. Eighty-three per cent of the selected subjects drank water more than twice daily. Fruit juice was consumed by 48 per cent, never or less than once or twice a week. Consumption ranged from 59 per cent never drinking whole milk to 16 per cent daily. Likewise rare were soft drinks; 63 per cent of the selected subjects never drank soft drinks.

The study analysed the risk of polycystic ovary syndrome (PCOS) among the selected subjects based on their Risk Assessment Scores and Hirsutism Scores. The results showed that 61 per cent of the subjects were classified as 'low-risk category', while 22 per cent had 'no risk category'. Seventeen per cent were in the 'moderate-risk category', and less than one per cent were in the' high-risk category'. In terms of hirsutism, 61 per cent of the study subjects had low hirsutism scores, suggesting minimal risk for hyperandrogenism. Only 11 per cent were categorised as moderate risk, and less than one per cent were in the high-risk category. The study also found that 49 per cent of the selected subjects had high-risk Assessment and Hirsutism scores, indicating a small proportion at significant risk for PCOS. Additionally, 13 per cent had high RA scores alone, suggesting that the selected subjects might be at risk based on factors such as menstrual irregularities and family history, despite not exhibiting overt symptoms of hirsutism. Overall, 25 per cent were identified across these categories.

The statistical analysis of the present study found significant relationships between hirsutism in specific areas and risk assessment scores for polycystic ovary syndrome (PCOS) and Body Mass Index (BMI). The strongest correlation was observed in the lower abdomen, followed by the upper lip and upper abdomen. Other areas, such as the chin and thighs, also showed a significant correlation. The strongest correlation was found in the upper lip and chin, suggesting that individuals with higher BMI might also experience increased hair growth in these areas. However, other locations, such as the chest and arms, showed no significant correlations with BMI. These results emphasized the importance of specific hair growth patterns as indicators of PCOS risk and potential metabolic implications in PCOS subjects. The study underscored the need for a multifaceted approach to diagnosis and management that considered various clinical features, including menstrual health, hirsutism, and metabolic factors.

The present study also looked into the physical symptoms linked to medical conditions including anaemia, obesity, underweight, osteoporosis, and pre-diabetes. For many different health conditions, including anaemia (4 per cent), obesity (6 per cent), underweight (2 per cent), osteoporosis (1.5 per cent), and prediabetes (4 per cent), the study revealed that a sizable portion of selected subjects reported more than three symptoms. More than three symptoms in these disorders could point to a greater risk for women with PCOS since they could have similar

difficulties with insulin resistance and hormonal imbalance. With obesity, underweight, osteoporosis, and prediabetes, anaemia showed a modestly positive correlation indicating that the likelihood of the other also increased as one condition increased. With osteoporosis and prediabetes, obesity also showed modest positive correlations that highlighted the need for combined approaches in treatment and preventative plans.

Recent studies revealed significant gaps in knowledge about Polycystic Ovary Syndrome (PCOS), particularly its long-term health implications. While 49 per cent of the selected study subjects knew about PCOS, 69 per cent were aware of problems of PCOS, primarily menstrual problems and later there is a problem of pregnancy delays. Only 16 per cent were aware of the treatment options, with weight reduction being the most recognized method. Symptoms associated with PCOS were notably lower, with 52 per cent recognized irregular menstrual cycles as a symptom. Family class is a significant predictor of knowledge about PCOS.

The study was executed to evaluate the nutritional and health status using anthropometric measurements including height, weight, waist circumference, hip circumference, computation Body Mass Index (BMI), and waist-hip ratio (WHR), the possible effects of PCOS on the selected subjects. The very little variation in height measurements among the study groups indicated that height might not be a major difference. The experimental groups had higher mean BMIs, suggesting they may be approaching or exceeding normal weight ranges into overweight categories. This is concerning given the link between obesity and worsened PCOS symptoms. Measuring waist circumference, hip circumference, and WHR as well, the experimental groups showed much larger means ranging from 66.900 cm to 71.250 cm while the control group had a mean waist circumference of 64.871 cm.

The study analyzed the biochemical profile of the selected PCOS Study subjects before implementing the intervention, focusing on parameters such as random blood sugar (RBS), cholesterol level, and haemoglobin (Hb). The control group had a stable glucose level, while the experimental groups showed lower RBS values, suggesting better glycaemic control. Cholesterol levels varied among the study groups, with the control group having a mean cholesterol level of 142.9 mg/dl, while the experimental group had the highest at 151.9 mg/dl, raising concerns about dyslipidemia, a common issue in women with PCOS that can contribute to cardiovascular disease risk. Haemoglobin levels were relatively stable, but menstrual irregularities could affect them over time.

Examining pre-assessment phase acne scores, the study revealed significant new information on the frequency and degree of acne among the study subjects, especially in relation

to Polycystic Ovary Syndrome (PCOS). With a median of 3.00 and a standard deviation of 3.69, the control group had a mean acne score of 4.29, therefore indicating a broad range of values from 0 to 12. By means of lower mean scores, the experimental groups revealed varying degrees of acne severity, presumably under the effect of hormonal abnormalities unique to PCOS.

The study examines the profile of Polycystic Ovary Syndrome (PCOS) symptoms among selected participants using the Cronin Questionnaire. The results show that the control group experienced moderate symptoms, while Experiment Group I had slightly more severe symptoms. Experiment Group II showed a significant decrease in the mean score, suggesting more significant complications or symptoms. Experiment Group III had considerable variability in symptom severity. Two main conclusions from the one-way ANOVA (Welch's analysis) were a highly significant difference in pre-PCOS scores ($F = 7.67$, $p = 0.001$) and a non-significant difference in acne scores across the four study groups ($F = 0.839$, $p = 0.477$).

Dietary patterns of the selected PCOS study subjects were compiled using the 24-hour dietary recall technique. The findings revealed notable energy intake deficiencies, especially in Experiment Group III. For PCOS study subjects, this could cause weight gain or impede efforts at weight loss—two important considerations. With 34.13 g of protein, Experiment Group III had the lowest intake—which could not be sufficient for metabolic health and muscle maintenance. Fat intake of the study group subjects varied greatly in terms of Experiment Group III consumed 24.08 g more than the EAR of 20 grams. Mineral intake exposed alarming deficits among the study participants of the four study groups. The collected data particularly on calcium and magnesium, revealed that the actual Calcium intake was found to be below the EAR of 800 mg, ranging from 234.07 mg in Experiment Group III to 252.02 mg in Experiment Group I. All the experimental groups had low magnesium intake and pointed out that Experiment Group III had an EAR of 270 mg while its mean intake was just 98.32 mg. Iron intakes ranging from 6.37 mg in Experiment Group III to 7.79 mg in the Control group—were below the EAR of 15 mg. Iron and zinc intake of the selected PCOS study subjects were likewise considerably lower than the EAR across four study groups.

Ultrasound imaging is crucial for diagnosing Polycystic Ovary Syndrome (PCOS), an endocrine disorder characterized by reproductive and metabolic symptoms. In a study, 40 per cent of study participants underwent ultrasound scanning. 39 per cent of study participants had polycystic ovaries, aligning with diagnostic criteria for PCOS.

To better grasp their consequences for reproductive health, the study examined menstrual hygiene practices followed among the sub-sample of the selected PCOS study. With rates ranging from 60 per cent in Experiment Group III to 78.1 per cent in Experiment Group I, most

participants used throw-away sanitary pads. Experiment Group III (40 per cent) had more usage of cloth or towel as a menstruation material than other study groups, implying either cultural or financial influence on material choice. Among the subjects, 66 per cent said that they wash two or more times daily, so the frequency of genital washing differed also. Regarding the disposal of menstrual products, most participants said they used latrines or toilets, which raises environmental problems and possible sanitation problems if improperly handled. Twenty-one per cent of subjects also reported burning items, therefore emphasizing cultural customs related to menstrual waste disposal.

Across the study groups—Control, Experiment Group I, Experiment Group II, Experiment Group III—the Godin Leisure-Time Exercise Questionnaire (GLTEQ) evaluated physical activity levels. The selected PCOS study subjects were categorized into three activity levels—Active, Moderately Active, and Sedentary. Regarding physical activity involvement among all four groups, the data revealed a notable trend. Many people, meanwhile, stayed inactive, which is connected to health issues like obesity and metabolic disorders like Polycystic Ovary Syndrome (PCOS).

Pre-assessment of Participants' perceived stress gave information about the psychological and emotional terrain, especially for subjects with disorders like PCOS. The majority of participants reported moderate stress, which negatively affected their overall health. However, in Experiment Group II, there was an increase in high sores of stress, while in Experiment Group III, only 16 per cent experienced low stress. This highlights the need for effective stress management strategies.

The study was initially, nutrition knowledge on Polycystic Ovary Syndrome (PCOS) analysed among the study participants of different study groups. The results showed that the control group had a basic understanding of PCOS, with 50 per cent of participants scoring less scores. Experimental Group I had a higher mean score of 14.4, reflecting a more robust grasp of PCOS concepts. Experimental Group II had a slightly higher mean score of 12.7, suggesting similar levels of understanding. Experimental Group III had a mean score of 13.7, indicating consistent knowledge levels among the selected participants.

In phase three, a nutrient-dense health mix powder and education module were developed. Considered for dietary supplements, the sensory evaluation examined three variations of the formulated Nutrient Dense Health Mix powder. Variation III outperformed the others in most attributes, particularly in Appearance (5.6), Aroma (4.4), and Taste (4.6). It achieved the highest ratings for Overall Acceptability (3.6) and Texture (3.3).

The Nutrient Dense Health mix powder consists of a variety of nutrients, including energy, fat, carbohydrates, and protein, as well as vitamins and minerals. The energy content was able to meet 27.2 per cent of the ICMR RDA for young adult women, making it beneficial for those needing higher caloric content. The powder also contained 14.8 g of fat, which meets 74 per cent of the ICMR RDA. The carbohydrate content was 48.5 per cent of the ICMR RDA, while the protein level was 36 per cent and Fibre content was substantial to meet the nutritional requirement of the young adult women. The health mix powder also contributed vitamins and minerals, in terms of 230 mg of calcium, 74 mg of magnesium, 19.1 mg of iron, zinc (4.8 mg), selenium (20 mcg), phosphorus (210 mg), potassium (628 mg), thiamine (1.2 mg), riboflavin (1.8 mg), and niacin (2.7 mg. This nutrient composition analysis revealed the potential benefits of incorporating a nutrient-dense health mix powder into daily routine dietaries to enhance the quality and quantity of nutrient content of the daily dietaries.

The physicochemical and Microbiological analysis was carried out for the formulated nutrient-dense health mix powder at two times—the 5th and 40th day of storage. The physicochemical characteristics of the health mix powder—including appearance, colour, odour, and pH were evaluated and indicated good stability. The pH dropped from 6.8 on the fifth day to 6.6 on the forty-first day, but it stayed within the reasonable range of 6.5 to 8.0. By the 40th day, the overall bacterial count dropped from $200x10^{i}$cfu/g to 12 x 10^{1} cfu/g, suggesting good over-time microbial control. Safety of the health mix powder was shown by the overall fungus count and stayed well below detectable levels (<10cfu/g). The nutritional powder proved free of dangerous heavy metals such as lead, mercury, arsenic, cadmium and nickel

The cost-effectiveness of the developed nutrient-dense health mix powder was calculated and the cost was Rs 27.63/100g, considering the economic possibility of developing nutrient-dense health mix powder while including PCOS diet options at an affordable level. Comparing Nutrient Dense Health Mix Powder to other commercial formulae for PCOS treatment showed a considerable price benefit with suitable nutrients.

In phase four the effect of nutrition intervention programs on nutritional status and knowledge of the participants for 90 days was evaluated. The results showed that especially in focused techniques, nutrition education significantly improved knowledge acquisition. The control group showed minimal change, while the experimental groups showed significant improvements. There was no statistically meaningful improvement. The pre-test mean score for Experiment Group I was 14.4, while the post-test mean score was 20.0. Significant gains were observed in Experimental Group II, with a mean difference of -11.4 ($F = 293$, $p < 0.001$) between pre-test and post-test mean scores of 12.7 and 24.0, respectively. In Experimental Group III, the

mean difference between pre-test (13.7) and post-test (25.3) was -11.6 ($F = 760$, $p < 0.001$). Results showed that there was a significant effect on the nutritional knowledge of the study participants due to the nutrition education programme for 90 days.

The effect of nutrition interventions on anthropometric measurements, particularly height, weight, and Body Mass Index (BMI), in managing conditions including Polycystic Ovary Syndrome (PCOS) was analysed. The results showed that height remained consistent across all study groups, while significant changes were observed in weight and BMI among the study participants of experimental groups compared to the control group. This suggested that targeted nutrition intervention effectively influenced body composition and overall health in women with PCOS.

The control group showed that there was a meagre increase in waist circumference, while the experimental groups showed significant reductions in waist circumference and hip circumference. The waist-to-hip ratio is an important indicator of body fat distribution and associated health risks. The control group displayed no significant change in WHR, but the experimental groups showed a statistically significant reduction in WHR, suggesting an improvement in body composition that could lead to better metabolic health outcomes.

The effects of nutrition interventions biochemical profile of participants with Polycystic Ovary Syndrome (PCOS) were examined. The control group showed minimal changes in these biochemical parameters, while the experimental groups demonstrated significant improvements. Random blood sugar (RBS) levels showed a significant decrease in three experimental groups. Regarding cholesterol levels, all study groups showed minimal changes, with p-values indicating no significant differences ($p > 0.05$). Haemoglobin levels varied among the study groups. The control group reported a decrease of 0.429 g/dL ($F = 30.5$, $p < 0.001$), while Experimental Groups I and II reported decreases of 0.144 g/dL and 0.368 g/dL (both $p < 0.01$). In contrast, Experimental Group III had an increase of -0.167 g/dL ($F = 13.1$, $p = 0.001$).

Emphasizing pre- and post-nutrition intervention evaluation, the study looked at the different dietary interventions that affected grades of acne. In the Control group, the mean difference was 0.00. This indicates no fluctuation in acne severity, serving as a baseline for the experimental groups. Experiment Group I had a pre-intervention mean of 3.22 (SD: 4.05) and a post-intervention mean of 3.19 (SD: 3.84) suggesting minimal to no effect of the nutrition intervention on acne severity. In Experiment Group II, participants had a pre-intervention mean score of 3.09 (SD: 2.18) and a post-intervention mean of 3.00 (SD: 2.05), indicating a slight improvement that was not statistically significant at conventional levels ($p < 0.05$). Experiment Group III showed more promising results, with a pre-intervention mean score of 3.53 (SD: 2.83)

and a post-intervention mean of 3.30 (SD: 2.48). The mean difference was greater at 0.233, with an F value of 6.43 and a p-value of 0.017, indicating statistical significance in the reduction of acne severity following the nutrition intervention and suggesting effective treatment in this study group participants.

In evaluating the nutrient intake of the study participants across three experimental groups, each undergoing different dietary interventions aimed at managing symptoms of Polycystic Ovary Syndrome (PCOS) and drew the comparisons based on pre-and post-intervention data. The analysis focused on key macronutrients and micronutrients, assessing which group demonstrated the most beneficial changes.

Experiment Group I showed a statistically significant decrease in energy intake from 1011.28 kcal pre-intervention to 1048.52 kcal post-intervention, with a mean difference of -37.2 kcal ($p = 0.047$). Experiment Group II also experienced a significant decrease from 994.78 kcal to 1074.47 kcal, yielding a mean difference of -79.7 kcal ($p < 0.001$). Experiment Group III had the most substantial reduction, with energy intake decreasing from 969.85 kcal to 1054.85 kcal (mean difference -85.0 kcal, $p < 0.001$). Thus, while all groups reduced energy intake, Experiment Group III had the highest post-intervention intake. In terms of carbohydrate intake, Experiment Group I decreased from 170.78 g to 164.39 g (mean difference of -6.39 g, $p = 0.019$), indicating a significant reduction. Experiment Group II also showed a significant decrease from 147.61 g to 138.57 g (mean difference -9.05 g, $p = 0.007$). Experiment Group III had the largest reduction, decreasing from 156.93 g to 145.53 g (mean difference -11.4 g, $p = 0.002$). Therefore, while all groups demonstrated decreases in carbohydrate intake, Experiment Group III again had the most significant reduction in the intake of carbohydrates in the daily diet.

Calcium intake significantly increased in all groups post-intervention. Experiment Group I from 252.02 mg to 274.63 mg (mean difference -22.6 mg, $p = 0.009$), Experiment Group II from 234.08 mg to 272.57 mg (-38.5 mg, $p < 0.001$), and Experiment Group III from 239.97 mg to 284.58 mg (-44.6 mg, $p < 0.001$). Experiment Group III exhibited the highest calcium levels of the post-intervention. Magnesium levels improved across all groups. Experiment Group I increased from 137.13 mg to 147.03 mg (mean difference -9.90 mg, $p = 0.017$), Experiment Group II from 98.32 mg to 112.95 mg (-14.6 mg, $p < 0.001$), and Experiment Group III from 112.85 mg to 128.95 mg (-16.1 mg, $p < 0.001$). In conclusion, Experiment Group III achieved the highest magnesium intake after the nutrition intervention programs for the period of 90 days.

Iron intake improved significantly in all the study groups. Experiment Group I increased from 6.92 mg to 8.09 mg ($p = 0.011$), Experiment Group II from 6.58 mg to 7.26 mg ($p = 0.005$), and Experiment Group III from 6.37 mg to 7.60 mg ($p < 0.001$). Zinc levels showed similar patterns. Experiment Group I rose from 3.47 mg to 4.04 mg ($p = 0.021$), Experiment Group II increased from 2 .52mg to 3 .84mg ($p < 0.001$), and Experiment Group III revealed an increase from 3 .01mg to 4 .61mg ($p < 0.001$). In both cases, Experiment Group III maintained the highest post-intervention levels of zinc.

This study also assessed the level of stress before and after the nutrition intervention programs for 90 days. The study categorized stress levels into high, moderate, and low. The research data revealed that the control group showed no significant change in stress levels, with a mean difference of -0.194 and a p-value of 0.206, indicating stability in stress perception. In contrast, Experiment Group I experienced a slight reduction in stress levels (mean difference of 0.406, $p = 0.021$), suggesting a positive effect of the nutrition intervention. Experiment Group II demonstrated a significant decrease in stress levels, with a mean difference of 2.13 and a highly significant p-value of <0.001, confirming the intervention's effectiveness. Similarly, Experiment Group III showed a substantial reduction in stress levels (mean difference of 2.70, $p < 0.001$), further highlighting the success of the nutrition intervention programs for study groups.

The study also investigated the effect of nutrition interventions on the symptoms of Polycystic Ovary Syndrome (PCOS). In the study on weight-related problems, the control group maintained a mean score of 31.5, showing no change. Experiment Group I increased slightly from 27.9 to 28.2 (mean difference: -0.313, $p = 0.048$), while Experiment Group II rose from 25.3 to 25.8 (mean difference: -0.469, $p = 0.009$). Experiment Group III showed the most significant improvement, increasing from 23.1 to 25.3 (mean difference: -2.23, $p < 0.001$). For menstrual problems, the control group remained at 22.4, whereas Experiment Group I increased from 26.5 to 27.0 (mean difference: -0.500, $p = 0.037$). Experiment Group II decreased significantly from 20.8 to 21.8 (mean difference: -1.06, $p < 0.001$), and Experiment Group III showed a notable change from 21.2 to 24.4 (mean difference: -3.27, $p < 0.001$). In hirsutism, the control group had a constant score of 27.6, with minimal changes in Experiment Groups I and II, but Experiment Group III improved significantly from 25.4 to 27.1 (mean difference: -1.67, $p < 0.001$). All the study groups showed no change in infertility-related concerns, maintaining scores around 19.4. Lastly, the control group's emotional problems score remained at 45.2, with Experiment Group I slightly increasing from 49.2 to 49.3 ($p = 0.211$) and Experiment Group II decreasing from 43.3 to 43.6 ($p = 0.077$). However, Experiment Group III experienced significant

improvement from an initial mean of 44.1 to a post-intervention mean of 45.8 (mean difference: -1.67, $p < 0.001$), indicating the effectiveness of the nutrition intervention programs for emotional distress related to PCOS.

Current research on PCOS highlights the connection between the PCOS condition and factors such as diet, physical exercise, stress management, nutritional status, and nutritional knowledge. This understanding empowers individuals to take an active role in their reproductive health care, leading to better management of PCOS symptoms and overall health improvement for participants.

g) Papers Published

- Jolly, T.T and Thirumani, Devi, A. (2023). Ragi health mix for managing polycystic ovarian syndrome: Formulation and nutrient analysis. The Journal of Research ANGRAU. 51(2):75-81. DoI: https://doi.org/10.58537/jorangrau.2023.51.3.09 -UGC CARE List Group 1
- Jolly, T. T and Thirumani Devi A. (2024). Dietary Habits and Nutritional Risk in College Girls: A Study in Thrissur, Kerala. The Indian Journal of Home Science. 36(2):268-280 - UGC CARE List Group 1

h) Conclusion

- The study found that 25 per cent of the 1250 young women screened were diagnosed with PCOS symptoms using the Rotterdam Criteria. It emphasizes the necessity for comprehensive screening and early intervention strategies to effectively manage risk factors associated with PCOS among young adult women.
- There were multiple macro and micronutrient deficiencies among the selected subjects that will affect the PCOS symptoms.
- The strong positive correlation between BMI and PCOS symptoms proved the role of weight reduction in PCOS management.
- The Nutrition Education Intervention improved the nutritional knowledge about PCOS among the selected study subjects indicating the importance of nutrition education in managing PCOS symptoms and improving the overall health of selected subjects.
- Physical exercise training and dietary supplementation had a positive impact on the nutritional status and symptoms of PCOS in selected study subjects in the experiment groups. It showed the effectiveness of dietary interventions in managing health issues associated with PCOS and empowered to take an active role in reproductive health care and also promotes health and wellness with the prevention of reproductive illness.

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